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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/902,728	07/12/2001	Arpan P. Mahorowala	YOR920000789US1	9522
7590 04/01/2004 Connolly Bove Lodge & Hutz P.O. Box 19088 Washington, DC 20036-3425			EXAMINER BARRECA, NICOLE M	
			ART UNIT	PAPER NUMBER

1756

DATE MAILED: 04/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/902,728

Applicant(s)

MAHOROWALA, ARPAN P.

Examiner

Nicole M. Barreca

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 18, 19 and 22-26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10/18/02 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1-26 are pending in this application. Claims 18, 19, 22-26 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 5.

Drawings

2. The drawings are objected to because Figures 1B, 2B and 4B are not labeled.

Claim Objections

3. Claim 12 is objected to because of the following informalities: "CI-6-alkyl, CS-2o" in line 4 and "CI-6-alkyl" in line 7. Appropriate correction is required.

Response to Amendment

4. The declaration filed on 1/5/2004 under 37 CFR 1.131 has been considered but is ineffective to overcome the Ngo reference.

5. The declaration states that Fig.1 of the application is dated July 13, 2000, which is prior to the filing date of Ngo. However the applicant's specification describes Fig.1 as a resist image after wet development. The applicant's claims require coating an organic underlayer and a photoresist, exposing, developing, transferring the image through underlayer to substrate and treating the image with a chemically reducing plasma. Fig.1 does not describe an image wherein an organic underlayer is coated, the image is transferred through the underlayer to the substrate and the image is treated with a chemically reducing plasma, as recited in the applicant's claims. Therefore the scope of the declaration is not commensurate with the scope of the claims.

Response to Arguments

6. Applicant's arguments filed 1/5/2004 have been fully considered but they are not persuasive because the 37 CFR 1.131 declaration is ineffective to overcome the Ngo reference. However please note that the previous 102 rejection has been changed to a 103.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 1-3, 7-17, 20-21 are rejected under 35 U.S.C. 102(e) as being anticipated by Ngo (US6528432), (with Linn (US 5833758) cited to show inherent properties) in view of Allen (US 5985524).

9. Ngo discloses a H₂ or H₂/N₂ plasma treatment in order to prevent organic ILD degradation. Figure 4 illustrates interlayer dielectric (ILD) 50 overlying a substrate. ILD 50 may comprise an organic carbon-containing low-k material. An organic carbon-containing low-k ILD 52, such as SiOCH (applicant's organic underlayer), is formed over layer 50 and patterned to form a trench using conventional damascene techniques (i.e. photoresist patterning, transferring photoresist pattern to underlying layer). Exposed surfaces are treated with H₂ or H₂/N₂ plasma in order to reduce pattern degradation, prior to photoresist stripping. Metal is deposited in the trench to form conductive line 70. See col.5, 54-col.6, 26 and figure 5. Ngo teaches using a H₂ or H₂-containing plasma

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in order to prevent degradation of a resist pattern in the subsequent processing steps.

Ngo however does not explicitly state that this H₂ or H₂-containing plasma is a chemically reducing plasma. However Linn teaches that H₂ is a chemically reducing plasma (col.3, 16-44), thereby teaching that the H₂ plasma used in the method of Ngo is inherently a chemically reducing plasma.

Ngo is silent on the specific details the damascene patterning process, such as on the specific photoresist material and exposure radiations used and does not disclose that the photoresist material forms a stable, etch-resistant, non-volatile oxide comprising an element selected from Si, P, Ge, Al and B (cl.2), that the photoresist comprises a polymer having acid-cleavable moieties (cl.11), that the photoresist comprises a polymer formed by polymerizing one or more monomers selected from acrylate, methacrylate, hydroxystyrene, cyclic olefin and having silylethoxy acid-cleavable moieties (cl.12), that the photoresist comprises a photoacid generator (cl.13), or that the radiation comprises electromagnetic or e-beam radiation (cl.14), UV or EUV (cl.15) or x-ray radiation (cl.16).

Allen discloses a method for forming bilayer resist images for use in the manufacture of integrated circuits. Conventionally the top layer of the bilayer resist contains silicon, boron or germanium which enable the use of oxygen reaction ion etching in the image transfer step. However the incorporation of silicon in the photoresist leads to resolution degradation. This bilayer method improves resolution and critical dimension (col.1, 37-56, cl.17). The top photoresist imaging layer comprises a photoacid generator. The photoresist also may comprise a polymer formed by

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polymerizing one or more monomers selected from acrylate, methacrylate, hydroxystyrene, cyclic olefin and having silylethoxy acid-cleavable moieties (col.2, 11-65, cl.2, 11-13). The photoresist is coated on an underlying organic layer, such as a low-k dielectric (col.3, 41-48, cl.9-10). The top layer is imagewise exposed to radiation such as UV, EUV, and x-ray (col.4, 13-21, cl.14-16). It would have been obvious to one of ordinary skill in the art to use photoresist material (that forms an oxide) comprising a material selected from Si, P, Ge, Al and B, comprising a polymer formed by polymerizing one or more monomers selected from acrylate, methacrylate, hydroxystyrene, cyclic olefin and having silylethoxy acid-cleavable moieties, and comprising a photoacid generator, and to expose the photoresist using electromagnetic, UV, EUV or x-ray radiation, as the photoresist for the damascene patterning in the method of Ngo (w/ Linn cited to show inherent properties) because Allen teaches that these photoresist and exposure radiations produce a bilayer resist image with improved resolution.

10. Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo (with Linn cited to show inherent properties) in view of Allen, as applied to claim 1, and further in view of Ni (US 6465159).

The teachings of Ngo, Lin and Allen have been discussed above. Ngo is silent on the method and gases used for transferring the trench pattern to the organic low-k underlayer, teachings only that the trench pattern is formed using conventional damascene techniques. Ngo therefore does not disclose that the (trench) pattern is transferred by etching using passivating chemistry which generates hygroscopic

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moieties such as a SO₂/O₂ containing plasma. Ni teaches that a conventional etch of organic low-k materials in a plasma chamber typically uses gases such as O₂, CO₂ and SO₂ (col.1, 48-50). It would have been obvious to one of ordinary skill in the art to transfer the (trench) pattern to the low-k organic layer in the method of Ngo (w/ Linn cited) in view of Allen by etching with a plasma containing O₂ and SO₂ gases because Ni teaches that a conventional etch of organic low-k materials in a plasma chamber typically uses gases such as O₂, CO₂ and SO₂.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 571-272-1378. The examiner can normally be reached on Monday-Thursday (8:00 am-6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Nicole M. Barreca

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Examiner

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3/18/04

Nick Bannen